

# Splitting of the Proximal Femur With a New Femoral Nail

MAJ Joseph R. Hsu, MD,\* CPT Daniel J. Stinner, MD\*  
COL David A. Brown, MD† and The Skeletal Trauma Research Consortium (STReC)

**Summary:** We present a case of a 19-year-old woman with a closed diaphyseal femur fracture and who had fixation of the fracture using a newer lateral entry nail, which resulted in an intraoperative proximal femur fracture. The patient underwent revision the following day and subsequently returned to regular activity without signs of implant failure or loss of reduction at latest follow-up. Caution should be exercised with the use of new implants that require a change in customary technique. In addition, some concern must be raised by the amount of offset from the top of this particular nail to its long axis.

**Key Words:** lateral entry, trochanteric nail, intramedullary nailing, femur, complication

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## INTRODUCTION

Antegrade femoral nailing using a trochanteric starting point has increased in popularity over the past few years.<sup>1–5</sup> One comparative study showed a trend toward shorter operative times and significantly decreased fluoroscopy times with a trochanteric starting point compared with a piriformis entry portal.<sup>4</sup> Both of these time differences were significant for obese patients. In addition, there seems to be some preliminary data to support a clinical advantage to nail insertion through the trochanter.<sup>1</sup>

Anatomically, the center of the femoral canal is below the junction of the medial aspect of the trochanter and the superior–lateral aspect of the base of the femoral neck.<sup>6</sup> To access the canal from a more lateral start point without introducing increased strain or malalignment in the proximal femur,<sup>7</sup> most modern nailing systems include a proximal lateral bend (valgus) of 4–6 degrees. This places the entry point at the tip of the trochanter. Some authors have criticized this starting point due the potential for gluteus medius tendon

injury,<sup>8</sup> whereas other authors have found greater soft-tissue injury by inserting a nail through the piriformis fossa.<sup>2,3</sup>

In an effort to eliminate soft-tissue injury when inserting an antegrade femoral nail, a recent nail, the Titanium Cannulated Lateral Entry Femoral Nail (Synthes USA, Paoli, PA) moved the entry point further lateral (10 degrees) and distal to completely avoid the gluteus medius tendon insertion. Furthermore, this nail has a helical shape in an effort to decrease bone stress and reduce the likelihood of iatrogenic intraoperative fracture.<sup>9</sup> The nail must be inserted with rotation to allow proper seating in the canal. The following is a case report of an intraoperative fracture using the new nail design.

## CASE

A 19-year-old woman involved in a head-on motor vehicle collision sustained a closed right diaphyseal femur fracture. The patient had a contralateral closed medial tibial plateau fracture. She had no other injuries and no relevant medical or surgical history. The patient was taking no medicines. Work-up of the patient's femur fracture included plain radiography of the femur (Fig. 1) and a thin-cut computed tomography scan of the proximal femur with 2-dimensional reconstructions (Fig. 2). The work-up confirmed a diaphyseal femur fracture without a concomitant fracture of the proximal femur. The patient was 65 in tall (167.64 cm) and weighed 109.8 lb (49.8 kg).

The patient went to the operating room approximately 5 hours after arrival and underwent supine antegrade nailing of her right femur fracture. The device used was a 10 mm × 40-cm Titanium Cannulated Lateral Entry Femoral Nail (Synthes USA). The entry point angle and location were performed as described in the technique manual for the product. This start point is 10 degrees lateral to the intramedullary canal measured from a point 40 mm distal to the lesser trochanter or 12 mm lateral to the tip of the trochanter.<sup>9</sup> The provided opening reamer was used under fluoroscopic control. The entire length of the femoral canal was sequentially reamed in increments of 0.5 mm to a diameter of 11.5 mm. A nail of 10 mm diameter was placed. The nail was introduced with the insertion handle in an anterior position to facilitate the proximal turn from the start point into the canal. The nail was allowed to rotate into proper orientation because it was advanced with gentle mallet blows as described in the product manual. Once rotation was confirmed radiographically, proximal and distal interlocking was performed.

Intraoperative fluoroscopy demonstrated a good reduction of the fracture and appropriate implant placement. There was no apparent iatrogenic proximal fracture. Plain

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From the \*United States Army Institute of Surgical Research, Fort Sam Houston, TX; and †Orthopedic Service, Brooke Army Medical Center, Fort Sam Houston, TX.

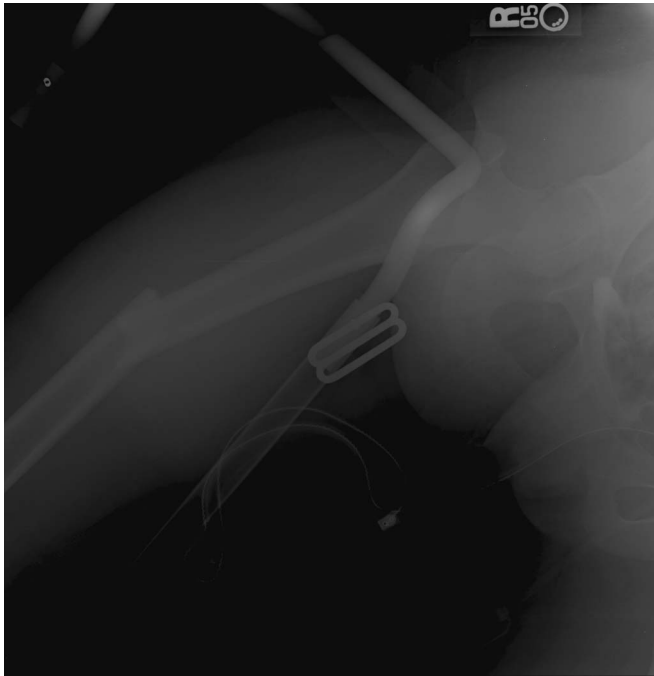
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Reprints: CPT Daniel J. Stinner, MD, Orthopedic Research Fellow, United States Army Institute of Surgical Research, 3400 Rawley E. Chambers Avenue, Fort Sam Houston, TX 78234 (e-mail: daniel.stinner@amedd.army.mil).

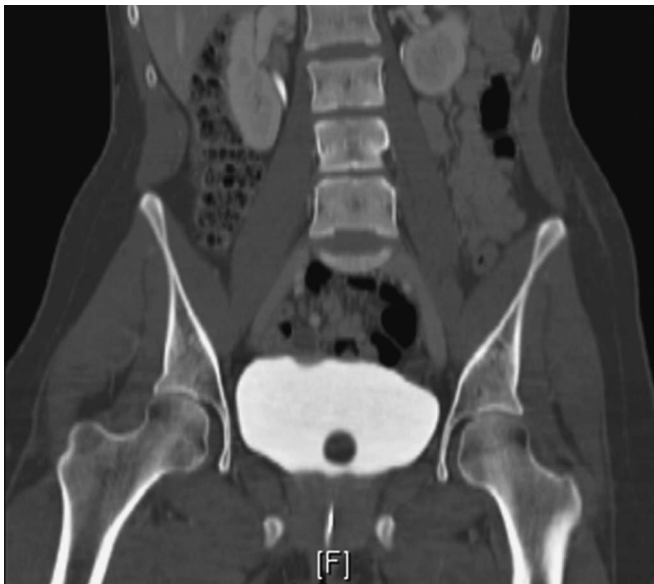
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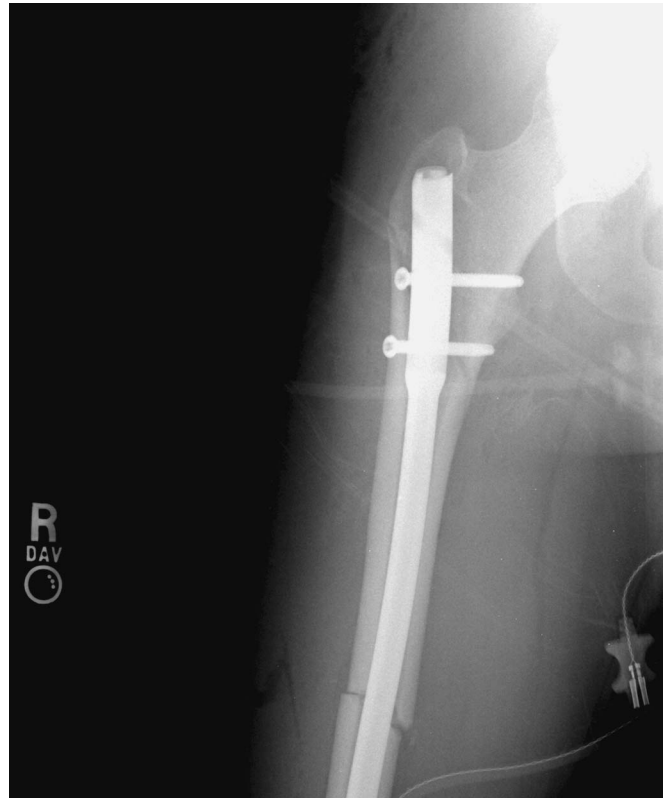


**FIGURE 1.** A radiograph of the right diaphyseal femur fracture obtained in the trauma bay.

radiographs of the hip taken in the postanesthesia care unit clearly demonstrated an oblique fracture of the proximal femur starting from a lateral point below the vastus ridge to a medial point 1 cm below the lesser trochanter. It did not appear to involve the entry portal (Fig. 3).



**FIGURE 2.** A thin-cut computed tomography scan of the proximal femur confirms no preoperative proximal femur fracture.



**FIGURE 3.** Postoperative radiograph of the hip demonstrates an oblique fracture of the proximal femur, which does not appear to involve the starting hole.

The patient and her family were told of the complication immediately after it was identified. Due to the patient having a tibial plateau fracture on the contralateral lower extremity, the decision was made to revise the fixation after discussion with the patient and her family to allow for immediate weight-bearing on her right lower extremity. The patient returned to the operating room the following day for implant removal and revision to a cephalomedullary nail (Fig. 4). The patient subsequently healed her wounds without signs of infection. At latest follow-up (9 months), the patient is full weight-bearing and has returned to regular activity without signs of implant failure or loss of reduction.

## DISCUSSION

Using the greater trochanter as an entry point for nailing femur fractures is not a new concept. It was first advocated by Gerhard Küntscher.<sup>10,11</sup> However, the use of a trochanteric start point with the early straight nails resulted in a mismatch between the contour of the femur and shape of the nail. This mismatch created a bending moment, which resulted in splitting and further comminution of the bone.<sup>12</sup> As use of these stiffer closed section implants evolved, nailing through the piriformis fossa gained popularity.<sup>12,13</sup> As mentioned, use of the trochanter as a starting point has regained popularity for both practical reasons<sup>4,14</sup> and to decrease soft-tissue injury<sup>2,3</sup> for potential improved clinical differences.<sup>1</sup>



**FIGURE 4.** A radiograph showing revision to a cephalomedullary nail.

There is a learning curve associated with using the trochanter as a starting point.<sup>15,16</sup> One study claimed that the learning curve can be overcome with each surgeon in the group averaging 6.4 cases during the learning curve.<sup>16</sup> The primary surgeon (D.B.) in this report is well beyond this learning curve for a standard trochanteric starting point at the tip of the trochanter.

The design of the Lateral Entry Femoral Nail (Synthes USA) includes a greater lateral proximal (valgus) bend of 10 degrees. This is similar to the proximal bend in the original Gamma Nail, which was subsequently revised to a 4-degree bend. Other common nails in the US market advocated for trochanteric entry are within 4–6 degrees<sup>4,5,7</sup> to limit their offset to the femoral medullary canal.

The increased bend of the lateral entry femoral nail (LEFN) is to avoid damage to the gluteus medius tendon that occurs with utilizing the tip of the trochanter as a starting point.<sup>2,3,8</sup> This “fissuring” of the proximal femur that occurred in our case has been reported in Gamma Nail cases in the past due to the exaggerated bend.<sup>16</sup> The LEFN has since been revised because of the excessive bend, which resulted in the fracture documented in our case. Due to the helical nail shape of these newer implants, however, iatrogenic splitting of the proximal femur may still be a problem if, during the rotational insertion of the nail, the bend mismatch causes a stress fracture of the shaft while seating the implant.<sup>9</sup>

It is very possible that the critical factor in this case may have been the size of the patient. She is slightly above average height for American women (63.8 in), but well below the average weight (163 lb.).<sup>17</sup> We would expect, however, that nail design be developed to accommodate a variety of sizes and shapes of femurs, as Asian and Hispanic females often exhibit these smaller and variable shaped femurs. Another critical factor may have been the learning curve associated with this specific device as in addition to a more lateral starting point, it requires a more vertical angle aiming at a point 40 mm below the lesser trochanter. The technique of precision entry and trajectory control using similar implants (4- to 5-degree valgus bends), aiming down the center of the medullary canal distal to the lesser trochanter, has been described.<sup>18</sup> However, many surgeons with trochanteric nailing experience are accustomed to aiming toward the lesser trochanter. Finally, the device used in this case was one of the early 10-mm nails, so it did not have the helical design. Perhaps, the lack of “rifling” contributed to increased proximal stresses. Irrespective of this fact, the excessive lateral bend in this nail created a wedge effect that resulted in a stress fracture when finally seated.

## CONCLUSIONS

Caution should be exercised with the use of any new implant requiring a change in customary technique. This case report is an example of the learning curve associated with a new device, and concern must be raised by the amount of offset from the top of this specific nail to its long axis. We would recommend that when using a trochanteric entry portal, consideration should be given to inserting nails that have a lateral offset of no more than 4–5 degrees to minimize proximal stress concentration and iatrogenic fractures of the proximal femur.

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